

WHAT IS CLAIMED IS:

1. A method of protecting a jet pump throat from downhole erosion comprising the steps of:

positioning a jet pump in a wellbore, the jet pump comprising

a nozzle and a throat;

pumping a power fluid through the jet pump at a sufficient velocity to

cause the power fluid pressure in the area between the nozzle and

throat to be less than or equal to the power fluid vapor pressure;

and

drawing solids-laden wellbore fluid into the jet pump and mixing the

wellbore fluid with the power fluid.

2. The method of claim 1 further comprising mixing the wellbore fluid and power fluid while the fluid pressure is less than or equal to the power fluid vapor pressure.

3. The method of claim 1 further comprising pumping the power fluid through the jet pump at a sufficient velocity to cause the power fluid pressure in the throat to be less than or equal to the power fluid vapor pressure.

4. The method of claim 1 further comprising transporting the mixture of power fluid and solids-laden wellbore fluid through the throat of the jet pump and out of the wellbore.

- 1 5. The method of claim 1 whereby the jet pump is positioned in the wellbore by
2 attaching the jet pump to a coil-in-coil tubing string and running the jet pump on
3 the coil-in-coil tubing into the wellbore.
- 4 6. The method of claim 5 further comprising delivering the power fluid to the jet
5 pump via the center tubing of a coil-in-coil tubing string.
- 6 7. The method of claim 5 further comprising returning the mixture of power fluid
7 and solids-laden wellbore fluid to the surface via the coil tubing-coil tubing
8 annulus.
- 9 8. The method of claim 1 wherein the power fluid pressure at the nozzle exit is about
10 absolute zero.
- 11 9. The method of claim 1 wherein the power fluid is selected from brine, water,
12 friction reduced water, gelled water, diesel, or hydraulic oil.
- 13 10. A method of protecting a jet pump throat from downhole erosion comprising the
14 steps of:
- 15 providing a jet pump in a wellbore, the jet pump comprising
16 a nozzle, one or more well fluid inlet ports, and a throat; and
17 pumping a power fluid through the jet pump at a sufficient velocity to
18 create cavitation vapor bubbles in the power fluid in the throat; and
19 drawing solids-laden wellbore fluid through the well fluid inlet ports
20 and mixing the wellbore fluid with the power fluid.
- 21 11. The method of claim 10 further comprising mixing the cavitation vapor bubbles
22 in the power fluid with the wellbore fluid .

- 1 12. The method of claim 10 further comprising pumping the power fluid through the
2 jet pump at a sufficient velocity to create cavitation vapor bubbles in the area
3 between the nozzle and throat.
- 4 13. The method of claim 10 further comprising transporting the mixture of power
5 fluid and solids-laden wellbore fluid through the throat of the jet pump and out
6 of the wellbore.
- 7 14. The method of claim 10 wherein the power fluid is selected from brine, water,
8 friction reduced water, gelled water, diesel, or hydraulic oil.
- 9 15. The method of claim 10 further comprising attaching the jet pump to a coil-in-coil
10 tubing string and positioning the jet pump at a desired location in the wellbore.
- 11 16. The method of claim 10 further comprising delivering the power fluid to the jet
12 pump via the center tubing of a coil-in-coil tubing string.
- 13 17. The method of claim 16 further comprising pumping the fluid mixture to the
14 surface via the coil tubing-coil tubing annulus.
- 15 18. The method of claim 10 wherein the power fluid pressure at the nozzle exit is
16 about absolute zero.
- 17 19. A method of protecting a jet pump throat from downhole erosion comprising the
18 steps of:
- 19 positioning a jet pump in a wellbore, the jet pump comprising
20 a nozzle and a throat;
- 21 pumping a power fluid through the jet pump at a sufficient velocity to
22 cause the suction pressure in the area between the nozzle and throat
23 to be less than or equal to the power fluid vapor pressure;

1 drawing solids-laden wellbore fluid into the jet pump and mixing the
2 wellbore fluid with the power fluid; and
3 transporting the mixture of fluid out of the wellbore.

4 20. A method of removing solids from a wellbore comprising the steps of:
5 positioning a jet pump in a wellbore, the jet pump comprising
6 a nozzle, a fluid inlet port and a throat;
7 pumping a fluid through the jet pump at a sufficient velocity to cause the
8 power fluid pressure in the area between the nozzle and throat to be
9 less than or equal to the power fluid vapor pressure; and
10 drawing solids-laden wellbore fluid into the jet pump through the fluid
11 inlet port and mixing the wellbore fluid with the power fluid.

12 21. The method of claim 20 further comprising mixing the wellbore fluid and power
13 fluid while the fluid pressure is less than or equal to the power fluid vapor
14 pressure.

15 22. The method of claim 20 further comprising pumping the power fluid through the
16 jet pump at a sufficient velocity to cause the power fluid pressure in the throat to
17 be less than or equal to the power fluid vapor pressure.

18 23. The method of claim 20 further comprising transporting the mixture of power
19 fluid and solids-laden wellbore fluid through the throat of the jet pump and out
20 of the wellbore.

21 24. The method of claim 20 whereby the jet pump is positioned in the wellbore by
22 attaching the jet pump to a coil-in-coil tubing string and running the jet pump on
23 the coil-in-coil tubing into the wellbore.

- 1 25. The method of claim 24 further comprising delivering the power fluid to the jet
2 pump via the center tubing of a coil-in-coil tubing string.
- 3 26. The method of claim 25 further comprising pumping the fluid mixture to the
4 surface in the coil tubing-coil tubing annulus.
- 5 27. The method of claim 20 where the jet pump is operated at a suction pressure of
6 about absolute zero.
- 7 28. A method of removing solids from a wellbore comprising the steps of:
8 providing a jet pump in a wellbore, the jet pump comprising
9 a nozzle, one or more well fluid inlet ports, and a throat;
10 pumping a power fluid through the jet pump at a sufficient velocity to
11 create cavitation vapor bubbles in the power fluid in the throat; and
12 drawing solids from the wellbore through the well fluid inlet ports and
13 mixing the solids with the cavitation vapor bubbles of the power
14 fluid.
- 15 29. The method of claim 28 further comprising mixing the cavitation vapor bubbles in
16 the power fluid with the solids .
- 17 30. The method of claim 28 further comprising transporting the mixture of power
18 fluid and solids through the throat of the jet pump and out of the wellbore.
- 19 31. The method of claim 28 further comprising attaching the jet pump to a coil-in-coil
20 tubing string and positioning the jet pump at a desired location in the wellbore.
- 21 32. The method of claim 31 further comprising delivering the power fluid to the jet
22 pump via the center tubing of a coil-in-coil tubing string.

- 1 33. The method of claim 32 further comprising transporting the solids to the surface
2 in the coil tubing-coil tubing annulus.
- 3 34. The method of claim 28 wherein the power fluid pressure at the nozzle exit is
4 about absolute zero.
- 5 35. A method of removing solids from a wellbore comprising the steps of:
6 pumping a power fluid to a downhole jet pump;
7 drawing wellbore solids into the jet pump and mixing the solids with the
8 power fluid while the fluid pressure of the power fluid is less than
9 or equal to the vapor pressure of the power fluid, and
10 transporting the solids-laden mixture through the throat of the jet pump
11 and out of the wellbore.
- 12 36. The method of claim 35 whereby the jet pump is positioned in the wellbore by
13 attaching the jet pump to a coil-in-coil tubing string and running the jet pump on
14 the coil-in-coil tubing into the wellbore.
- 15 37. The method of claim 36 further comprising delivering the power fluid to the jet
16 pump via the center tubing of a coil-in-coil tubing string.
- 17 38. The method of claim 36 further comprising returning the mixture of power fluid
18 and solids to the surface via the coil tubing-coil tubing annulus.
- 19 39. The method of claim 35 wherein the power fluid pressure at the nozzle exit is
20 about absolute zero.
- 21 40. The method of claim 35 wherein the power fluid is selected from brine, water,
22 friction reduced water, gelled water, diesel, or hydraulic oil.
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